CLAIMS

What is claimed is:

1. A PIN photodetector comprising:

a first semiconductor contact layer configured as a mini-mesa structure;

a semiconductor absorption layer, the mini-mesa structure having a smaller area than the semiconductor absorption layer;

a semiconductor passivation layer positioned between the mini-mesa structure and the semiconductor absorption layer, relative to the passivation layer and the absorption layer, the mini-mesa structure being in direct physical contact with only the passivation layer; and

a second semiconductor contact layer, the semiconductor absorption layer and passivation layers being positioned between the mini-mesa structure and the second semiconductor contact layer.

2. The photodetector of claim 1 wherein the semiconductor absorption layer is InGaAs.

3. The photodetector of claim 1 wherein the passivation layer is InAlAs.

4. The photodetector of claim 1 wherein the mini-mesa structure is a p-type and the second semiconductor contact layer is an n-type.

5. The photodetector of claim 1 wherein the mini-mesa structure is an n-type and the second semiconductor contact layer is a p-type.

6. The photodetector of claim 5 wherein the mini-mesa structure and the second semiconductor contact layer are InAlAs.

7. The photodetector of claim 1 further comprising a second semiconductor passivation layer positioned about the first semiconductor passivation layer and the semiconductor absorption layer.

8. The photodetector of claim 1 further comprising a first metal contact positioned adjacent to the mini-mesa structure and at least one second metal contact positioned adjacent to the second semiconductor contact layer.

9. The photodetector of claim 8 wherein the first metal contact is a p-type and the second metal contact is an n-type.

10. The photodetector of claim 8 wherein the first metal contact is an n-type and the second metal contact is a p-type.

11. The photodetector of claim 1 further comprising a first bandgap grading layer positioned between the semiconductor passivation layer and the semiconductor absorption layer and a second bandgap grading layer positioned

between the semiconductor absorption layer and the second semiconductor contact layer.

12. The photodetector of claim 1 wherein the electric field near the center of the semiconductor absorption layer is greater than the electric field near the edges of the semiconductor absorption layer.

13. The photodetector of claim 1 wherein the capacitance of the photodiode is determined by the area of the mini-mesa structure.

14. The photodetector of claim 1 wherein the photodiode has a dark current behavior that is substantially constant relative to an initial value.

15. The photodetector of claim 14 wherein the photodiode has a dark current behavior that is substantially constant relative to an initial value over a time period greater than 2000 hours.

16. The photodetector of claim 1 wherein the photodiode has a lifetime that exceeds twenty years.

17. The photodetector of claim 1, wherein the semiconductors include InP or other binary or tertiary III-V semiconductors.

18. A method of fabricating a PIN photodetector comprising:

providing a lower semiconductor contact layer;

depositing a semiconductor absorption layer;

depositing a semiconductor passivation layer; and

depositing or fabricating an upper semiconductor contact layer configured as a mini-mesa structure having a smaller area than the semiconductor absorption layer, relative to the passivation layer and the absorption layer, the mini-mesa structure being in direct physical contact with only the passivation layer.

19. The method of claim 18 wherein the semiconductor absorption layer is InGaAs.

20. The method of claim 18 wherein the passivation layer is InAlAs.

21. The method of claim 18 wherein the lower semiconductor contact layer is an n-type and the mini-mesa structure is a p-type.

22. The method of claim 18 wherein the lower semiconductor contact layer is a p-type and the mini-mesa structure is an n-type.

23. The method of claim 22 wherein both semiconductor contact layers are InAlAs.

24. The method of claim 18 further comprising depositing a second semiconductor passivation layer about the first semiconductor passivation layer and the semiconductor absorption layer.

25. The method of claim 18 further comprising depositing a first grading layer on the lower semiconductor contact layer and depositing a second grading layer on the semiconductor absorption layer.

26. The method of claim 18 wherein the semiconductors include InP or other binary or tertiary III-V semiconductors.